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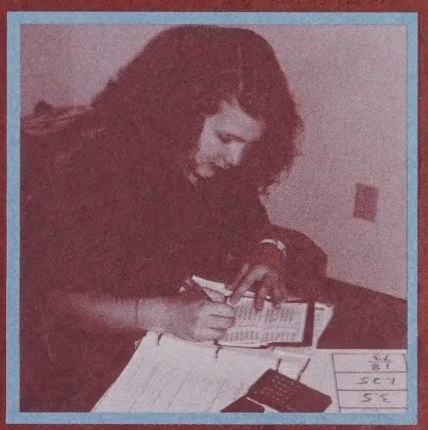
Mathematics

Grade 10
(General Level)

A REPORT CARD FOR ONTARIO



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PROVINCIAL REVIEWS

MATHEMATICS

Mathematics

Grade 10 (General Level)

Sample Questions From the Review

Selected questions from the Grade 10 mathematics review are reproduced below. Two boxes appear under each question. The left-hand box contains the percentage of students who answered the question correctly. The right-hand box contains the percentage of teachers who indicated that students had had the opportunity to learn the material or acquire the skills needed to answer the question. The opportunity-to-learn figure is not available for question 12.

The panel rating of students' performance is also given for each question.

1. Don and Yuri took a taxi back from a show. The following table compares distance (d) in kilometres and cost (c) in dollars.

d (km)	1	2	3	4	5	6	7
c ($)	1.30	1.50	1.70	1.90	2.10	2.30	2.50

The cost for a trip of 9 km would be:

a) $2.50 c) $2.90
b) $2.70 d) $3.10

84 95

Panel rating: strong

This question on application of numbers measures students' ability to extrapolate from tabulated data.

Introduction

Provincial reviews form part of the Ministry of Education's ongoing commitment to the monitoring of school programs. The results serve to inform the public about the performance of the educational system in Ontario and to assist schools, school boards, and the Ministry of Education in improving teaching methods and raising the level of student achievement.

A provincial review of mathematics was conducted in selected Grade 10 general level classes in Ontario during the spring of 1990. The main questions answered by the review were "How well are Grade 10 students achieving the goals of the general level mathematics curriculum?" and "How are Grade 10 students taught mathematics at the general level?" Highlights of the results are listed below.

Highlights

- Grade 10 students in general level mathematics are achieving at levels judged to be satisfactory or better in the majority of the topics in the course; achievement was rated strong in two topics, satisfactory in six topics, and marginal in four topics.
- Student achievement is strong in applications of numbers and in statistics.
- Student achievement is satisfactory in the following areas: applications of ratio, rate, and per cent; personal finance and banking; borrowing and saving; graphing; linear equations; and process problems.
- The following were identified as areas of weakness: powers and square roots; polynomials, formulas, and equations; geometry; and computations without the aid of calculators.
- The enrolment in Grade 10 general level mathematics is 56 per cent male and 44 per cent female. Achievement levels are slightly higher for male students than for female students.
- The majority of students believe that mathematics is important for employment, is helpful to them outside school, and is equally important for boys and girls. Nearly half of the students say they like mathematics.
- The most commonly used methods for teaching Grade 10 general level mathematics are presentation of information to the class by chalkboard or overhead projector and assignment of individual work.
- Thirty per cent of the teachers say that their students have access to computers for mathematics; 92 per cent of the students never use computers in mathematics class.
- Forty-three per cent of the students do no mathematics homework, and only 16 per cent of the students spend more than one hour per week on mathematics homework. Forty-two per cent of the students receive help with mathematics from someone at home.

2. The radius (r) of a circle is given by the formula $r = \sqrt{\frac{A}{3.14}}$, where A represents the area of the circle. If the area of a circle is 85 cm^2, then the radius is:

a) 0.19 cm
b) 2.9 cm
c) 5.2 cm
d) 27 cm

35 94

Panel rating: weak

This question requires students to use a calculator to find the square root of a number in a simple application.

3. A 100-mL tube of toothpaste sells for $1.75. The price per millilitre is:

a) $175.00
b) $57.14
c) $0.57
d) $0.0175

74 96

Panel rating: satisfactory

This question requires students to determine the unit price of a product.

4. 70 out of 100 students surveyed planned to vote for Liz for president. How many of the 1 000 students in the school may be expected to vote for Liz?

a) 700
b) 170
c) 100
d) 70

90 90

Panel rating: strong

This question on statistics measures students' ability to use data from a sample to estimate a characteristic of a population.

How was the review conducted?

Information was collected from students, teachers, and principals by means of questionnaires and mathematics test questions. The data in this report card are based on a provincial sample of English-language schools (4 181 students and 167 teachers). In addition, 48 boards chose to have all of their English-language schools administer the instruments so that they could receive summary data at the board and school levels.

A detailed presentation of the results of the provincial review is contained in *A Report for Educators*. Participating schools and school boards have received reports containing local results. A provincial review was also conducted in French-language schools, and parallel reports are available in French.

What types of questions were students asked?

Most of the questions in the student booklets were multiple-choice questions, to which students responded by choosing the correct answer from four possible responses. Some questions required a written response, such as a numerical or algebraic answer, a complete solution to a problem, or a graph. The students were permitted to use calculators for most of the questions. There were eight questions that tested the students' performance without calculators.

The assessment questions covered the following components of the mathematics curriculum:

1. Numerical methods:
- applying numbers; interpolating and extrapolating from tabulated data
- interpreting and applying powers and square roots
- applying ratio, rate, and per cent
- using sampling; critically analysing statistical tables, graphs, and statements
- applying record keeping to personal finance and banking
- identifying types of credit, savings, and loans; calculating the cost of credit

2. Algebra:
- adding and subtracting polynomials; multiplying by monomials; solving linear equations
- drawing graphs using tables of ordered pairs; interpolating and extrapolating from graphs
- drawing graphs of pairs of linear equations; solving pairs of linear equations graphically and numerically

3. Geometry:
- applying the angle properties of parallel lines, triangles, and quadrilaterals; determining the slope of line segments; calculating the distance between two points

4. Process problems:
- applying problem-solving strategies to unfamiliar problems

The questions were designed to assess abilities at three cognitive levels: recognition or recall, comprehension, and application. Recognition or recall required the student to recognize or recall a definition, concept, formula, or algorithm. Students demonstrated comprehension through the use of a concept, formula, or algorithm in a routine way requiring little analysis. Application questions required the student to solve problems requiring some analysis or non-routine problems requiring the choice of a strategy as well as analysis.

Selected questions from the assessment booklets are presented in the margins of this report card. The answers to these questions are also given.

5. Olav keeps a record of all his banking.

Date	Description	Debit	Credit	Balance
May 1	Carried forward			178.43
May 5	Cheque #121	19.86		158.57
May 10	Withdrawal	40.00		
May 15	Pay		72.10	

The balance on May 15 is:

a) $270.67 c) $126.47
b) $190.67 d) $46.47

71 70

Panel rating: satisfactory

This question measures students' ability to check a bank account balance.

6. Todd has an outstanding balance of $350 on his credit card account. The interest charge is 2 % per month. The amount of interest that will be charged for one month is:

a) $0.58 c) $84.00
b) $7.00 d) $357.00

82 83

Panel rating: strong

This question requires students to calculate the amount of interest owed in a simple example of borrowing.

7. E = IR is an important formula in electricity.

E represents the voltage in volts.
I represents the current in amperes.
R represents the resistance in ohms.

If E is 600 volts and R is 400 ohms, the current I is:

a) 1 000 amperes c) 1.5 amperes
b) 200 amperes d) 0.7 amperes

39 90

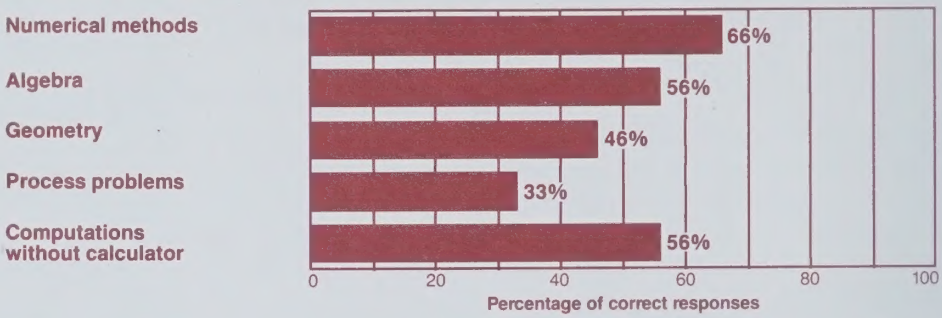
Panel rating: weak

This question requires students to substitute in a formula and solve the resulting linear equation.

How well did students perform?

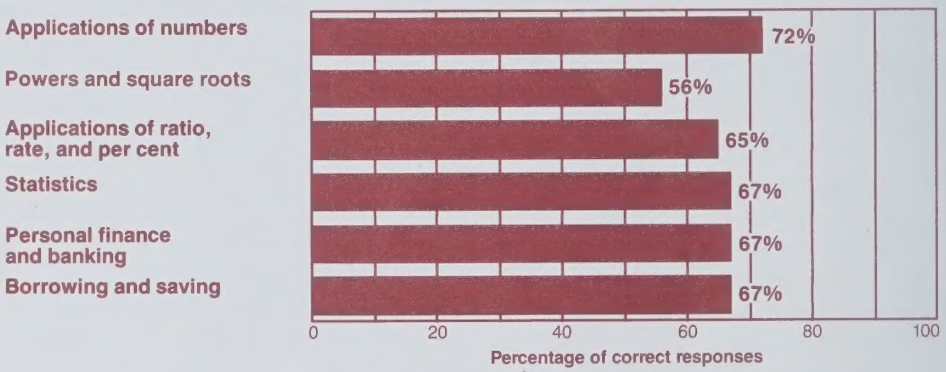
The average percentages of correct responses to questions in the main areas of the Grade 10 general level mathematics curriculum are presented in the following graph.

Summary of Student Achievement in Mathematics

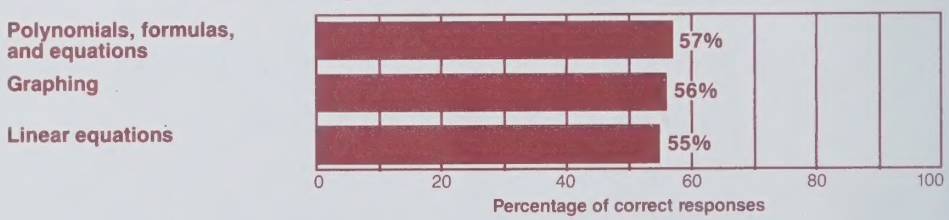


The graphs that follow show the percentages of correct responses for the specific topics within numerical methods and algebra.

Student Achievement in Numerical Methods by Topic

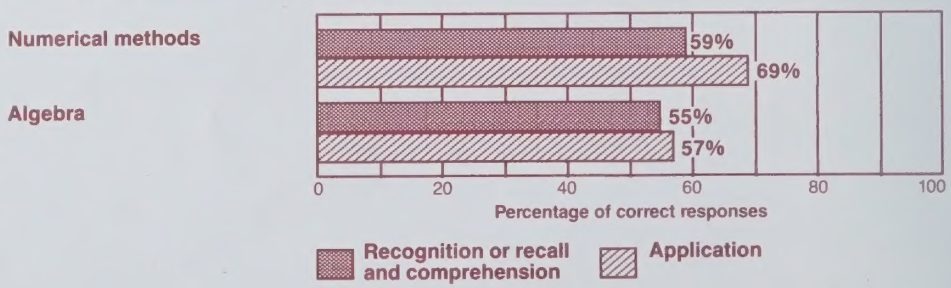


Student Achievement in Algebra by Topic

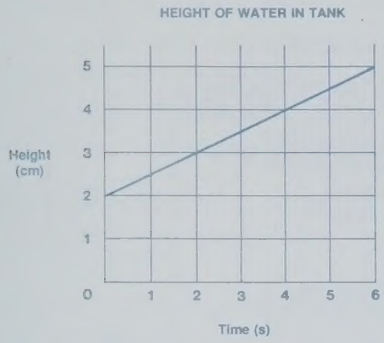


The following graph shows student achievement by cognitive level. Note that two of the cognitive abilities (recognition or recall and comprehension) were combined for this analysis. A breakdown by cognitive level was not computed for geometry because most of the geometry questions involved comprehension.

Student Achievement by Cognitive Level



8. A tank is being filled with water. The graph below shows the height of water in a tank for different times.



At 5 s, the height of water in the tank is:

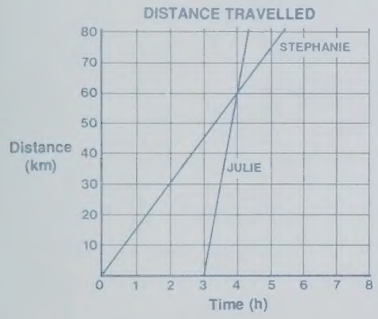
a) 6 cm
b) 5.5 cm
c) 5 cm
d) 4.5 cm

84 98

Panel rating: satisfactory

This question measures students' ability to read information from a graph.

9. Stephanie and Julie decided to travel the 90 km to their cottage one weekend. Stephanie rode a bike at an average speed of 15 km/h. Three hours after Stephanie left, Julie got in her car and drove along the same route at an average speed of 60 km/h. The graph below shows the distance each had travelled and the number of hours travelled.



When Julie catches up to Stephanie, how many hours has Stephanie been travelling?

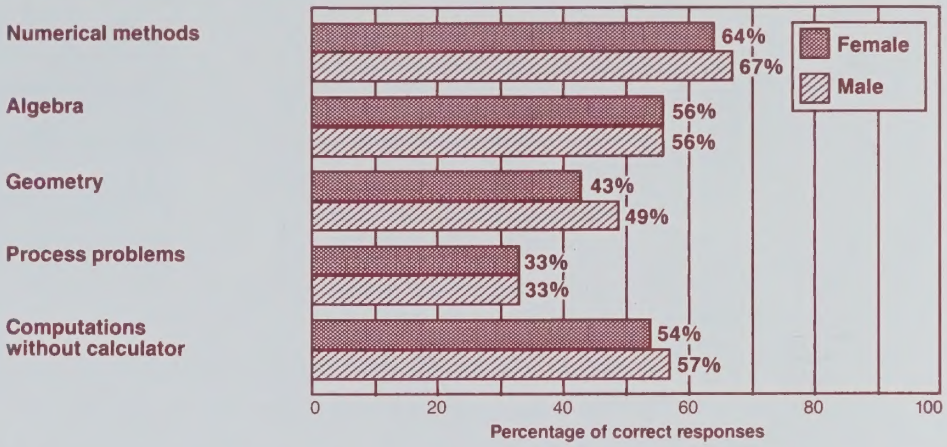
67 86

Panel rating: satisfactory

This question on linear equations measures students' ability to apply the concept of the intersection of two lines.

As shown in the following graph, achievement levels are slightly higher for male students than for female students for most topics. Student enrolment in the general level of Grade 10 mathematics is 56 per cent male and 44 per cent female.

Student Achievement by Gender

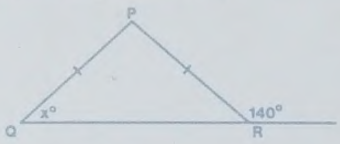


Interpretation panels composed of educators, parents, and trustees reviewed the test questions and the student results. Prior to seeing any student results, panel members established a standard for each question in the form of an expectation for student performance. Actual student achievement was then rated against these standards. Results were rated on a five-point scale: *superior, strong, satisfactory, marginal,* or *weak*. The panel ratings for the main curriculum areas and the specific topics are given below:

1. Numerical methods	***– satisfactory***
■ applications of numbers	*– strong*
■ powers and square roots	*– marginal*
■ applications of ratio, rate, and per cent	*– satisfactory*
■ statistics	*– strong*
■ personal finance and banking	*– satisfactory*
■ borrowing and saving	*– satisfactory*
2. Algebra	***– marginal***
■ polynomials, formulas, and equations	*– marginal*
■ graphing	*– satisfactory*
■ linear equations	*– satisfactory*
3. Geometry	***– marginal***
4. Process problems	***– satisfactory***
5. Computations without calculator	***– marginal***

As shown by the panel ratings, student achievement is strongest in numerical methods. Some weaknesses are evident in the areas of algebra, geometry, and work without calculators.

10. In the triangle below, PQ = PR.



The value of x is:

a) 40° c) 80°
b) 70° d) 140°

52 50

Panel rating: marginal

This question requires students to use the property of an isosceles triangle.

11. A contest was held to guess the number of peanuts in a jar. Four wrong guesses were made: Sabrina, 163 peanuts; Pierre, 169; Yasmine, 178; and Carlos, 185. One of these guesses was wrong by 1, another by 6, another by 10, and another by 16. How many peanuts are there?

28 19

Panel rating: satisfactory

This process problem requires the students to select a strategy and then solve the problem.

12. $23.857\,6 \times 10^3$ is:

a) 0.023 857 6 c) 23 857.6
b) 23.857 600 0 d) 238 576 000

57

Panel rating: marginal

This question, to be done without a calculator, measures students' knowledge of scientific notation.

How do students feel about mathematics?

Forty-eight per cent of the students say they like mathematics, 49 per cent say they are good in mathematics, and 33 per cent say that mathematics is difficult. Eighty-two per cent of the students consider mathematics to be important for employment, 75 per cent say that mathematics helps them outside school, and 94 per cent say that mathematics is equally important for boys and girls.

How will the results of the review be used?

The provincial results have been provided to the committees currently working on the formulation of benchmarks and the restructuring of education in Ontario. This detailed information will assist the committees in their specification of instructional strategies and selection of resources. Steps will be taken to reinforce the positive aspects of the mathematics program that have been identified and to ensure that procedures are implemented to strengthen weak areas. Improvements in the mathematics program will be achieved through the following activities, which are part of the ministry's action plan:

- a review of the mathematics curriculum guideline, to determine what changes should be made
- an examination of needs in the area of resource development
- the identification of needs in the area of teacher in-service

The schools and school boards involved in the review have been provided with their own results and will interpret them and make recommendations for program improvement. School boards will develop local action plans based on a complete study of their data. Action at the board level should include the following:

- a review of local policy and program documents
- an assessment of implications for staff development
- an examination of needs in the area of development of local resource materials
- preparation of a report, to be submitted to the Ministry of Education, on the actions that have been taken and that are planned

Answers to Questions:

1. c
2. c
3. d
4. a
5. b
6. b
7. c
8. d
9. 4 hours
10. a
11. 179
12. c

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